

Non-Chemical Weed Management in Apple Orchards

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Groundcover management in apple orchards is a critical component of successful fruit production. Apple trees require weed-free competition for at least part of the year and especially during the initial establishment years in order to maximize vegetative growth and fruit production. However, maintenance of a complete vegetation-free zone underneath and between trees in an orchard is not desirable, as it would lead to soil erosion and other declines in soil health and quality. Most northeastern orchards use a system which includes a permanent sod cover between orchard rows that can withstand tractor traffic, is perennial, and ideally is low-growing to minimize the need to mow during the growing season. Under trees in the tree row, a second groundcover zone is usually maintained, which may be as simple as a mowed strip of sod continuing from the row middles, or may be managed with herbicides, cultivation, or mulching.

The 'Weed Free Strip'

Apples have relatively deep roots compared to many weed species. However, changes in orchard architecture to favor dwarf rootstocks with shallow root systems make those trees less competitive with weeds than older, larger trees on semidwarfing or larger rootstocks. For those larger, established trees, a sod groundcover mowed with an offset mower may be acceptable, however, grasses and other covers growing under the trees may compete for water and nutrients and reduce crop yield and/or tree growth in subtle but measurable ways. Even deep-rooted semidwarf trees will benefit from reduced weed competition during orchard establishment.



Figure 1. Weed-free strip maintained under a young orchard.

It is not necessary or preferable to maintain a vegetation-free strip under apple trees all season, and in fact, doing so may lead to a decline in soil health. Research has shown that the critical weed-free period is from bloom through about mid-July, when tree growth and nutrient needs are greatest. That does not mean that weeds should be allowed to grow unmanaged late in the season, as perennial and vigorous weeds may cause problems later in the season or become difficult to manage. Groundcovers that grow up into the tree canopy can increase fungal disease, and tree trunks that are obscured by dense-growing vegetation have greater risk for borer problems than exposed trunks. Also, dense vegetation growing under trees increases vole habitat which can increase problems in the orchard during the following winter especially.

There are many methods to maintain under-tree vegetation for optimum orchard health, and it is best to use multiple practices. Goals for under-tree vegetation maintenance should include: excellent weed control from pre-bloom through July; maintenance or increase of soil organic matter levels (optimum is 3-6%); control of perennial, especially woody, weed species; and maintenance of under-tree groundcovers, when allowed, to maximize trunk exposure and reduce vole habitat.

Mowing



Figure 2. Mowing semidwarf trees with a swing-arm mower.

The orchard row middles typically require mowing several times per year to provide access through the planting for workers and equipment, to reduce vole habitat, and to reduce moisture in tree canopies. Mowers with a spring- or hydraulic-activated

swing arm may be used to mow vegetation under trees and even up close to the tree trunks. Mowed sod systems are only recommended for vigorous trees and in non-droughty soils. However, swing arm mowers may be used to maintain late-season vegetation allowed to grow in late summer and fall to prevent complications resulting from excessive vegetation growth. In some cases, 'brushing out' trees with weed whackers or machetes is necessary to control vegetation close to tree trunks or in the narrow band between trees.

Herbicide

Herbicides are commonly used to maintain a weed-free strip in orchard tree rows. There are many options for herbicides which are beyond the scope of this fact sheet. However, an integration of chemical and non-chemical approaches may improve overall tree row management. For example, systemic contact herbicides are effective tools for 'killing back' under-tree covers in late fall or spring, or for managing woody and/or perennial weed species that may become established when using non-chemical methods. There are a number of organic-certified herbicide products which, in our experience, are ineffective for this rescue or cleanup application and rather must be used only on young weeds that can be managed with other methods more cost-effectively.

There is danger of damaging trees with herbicides, especially when young and bark is easily penetrated by spray material. If using herbicides near young trees especially, very careful and exacting application methods should be used to minimize contact with bark and foliage.

Flame Weeding



Figure 3. Backpack flame weeders are relatively inexpensive and can spot-treat problem weeds but can start fires if not very carefully used.

Propane-fueled flame weeders are used successfully in some crops to manage weeds. The flame need not burn the whole plant, but must only raise the temperature enough to rupture

cells which leads to plant death. This can be achieved with a quick pass over the plants. However, this only kills the tops of plants and many weed species will quickly regrow from the roots. Also, flame weeding can damage low limbs and tree trunks if not applied very carefully. There is also danger of starting fires in dried thatch and other vegetation and damaging irrigation lines. Generally, flame weeding is not particularly effective in most orchard systems.

Under-Tree Cover Crops

There has been relatively little research in the use of cover crops planted under apple trees in the eastern U.S. Careful consideration must be made to ensure that in-row cover crops do not become competitive with the orchard crops. In addition, crop growth should be managed to ensure that it does not promote vole or borer habitat. Flowering cover crops grown during the season can complicate pest management, as wild pollinators and beneficial insects attracted to blooming cover crops may be adversely impacted by insecticide sprays applied to protect apple crops.

One tactic to consider in using under-tree cover crops is to broadcast seed in late summer onto bare (cultivated or herbicide-treated) soil so that crops may become established prior to harvest. Under tree cover crops should be mowed before winter to reduce vole pressure and to ease management the following spring. If broad-spectrum insecticides (other than lepidopteran-specific materials like codling moth granulosis virus or *Bacillus thuringiensis*) are to be used, the cover crop should be mowed prior to spray application to reduce vulnerable pollinator populations in the orchard.

Cultivation

Cultivation is simply the use of controlled soil disturbance to uproot weeds. Used properly, it can be an important tool for managing weeds and incorporating soil organic matter. However, excessive or overly aggressive cultivation can damage trees and reduce soil quality. Ideally, cultivation will only disturb the top 1-2" of soil. If used as the primary weed management practice it often must be performed four to six times per season to prevent weeds from becoming too large for it to be effective. Repeated cultivation may decrease soil organic matter and reduce overall soil quality.

The simplest cultivation tool is a hoe, which can be effectively used to maintain a weed-free area immediately around young tree trunks, but which is not practical on larger scales. However, hoeing around trees in a new planting will allow for more effective use of other tools without having to get too close to trunks and risk damaging trees.



Figure 4. Weed-free area maintained around newly-planted trees via hand-hoeing.

Tractor-mounted under-tree cultivators come in many makes and models. Cultivators with hydraulically-powered rotating tines may be useful for many orchard practices, including hilling up soil, removing berms in the tree middle, breaking up established sod, and general cultivation. However, their aggressive nature requires very careful operator attention and slow ground speeds which may limit their use in large plantings.



Figure 5. Hydraulic rotary cultivator (Weed Badger™, Marion, ND).

Another type of tractor-mounted cultivator uses ground-driven 'spider' wheels that are less aggressive than rotary tines but are also less effective against heavy sod and may not be used to move or level soil under trees for berm management. These cultivators may be operated at relatively high speed (5-7 mph) and this can cover a lot of ground quickly.



Figure 6. Wonder Weeder™ ground-driven under-tree cultivator, Harris Mfg., Burbank, WA.

Mulching

Mulches can provide very good weed control, but their benefits come with certain drawbacks. Inorganic groundcover-based mulched like plastics and landscape cloth provide habitat for voles and prevent nutrient and sometimes water assimilation into the soil and are not recommended for use in orchards. Leaves and straw can successfully control weeds but may be difficult or costly to source in large quantities and also provide excellent vole habitat.

Wood chips are probably the best organic mulch, and can often be sourced from municipal tree companies for relatively low cost or even for free. There is some concern that wood chips applied to the soil will tie up nitrogen, but that is debatable, and likely would only happen at the soil-mulch interface and not deeper in the soil profile where most tree roots are. Wood chips may be stockpiled and allowed to partially decompose for six months to one year prior to applying which can help to stabilize them and reduce potential for nutrient tie-up.

There hasn't been substantial research on types of wood chips for use in tree fruit plantings, but in our experience, mixed hardwood and softwood chips have performed well with no apparent issues with disease or allelopathy. Hardwood bark chip mulch from sawmills is sometimes available, but often costly. In research from New York, bark chip mulch was effective in reducing weed pressure and had almost no attractiveness to voles.

Wood chips should be applied 4-6 inches deep in order to be effective for weed control. Ideally, they would be applied to a clean, weed-free surface so herbicide application or cultivation prior to applying wood chips is recommended. Application may be done by hand, but that is often impractical on large acreages. Tractor-pulled, side-discharge mulch spreaders may be purchased or leased which can greatly speed application time

and efficiency. Weed control typically lasts 1-2 seasons before chips begin to break down and weeds which are suited to growing on top of mulch like quackgrass become established.



Figure 7. Mulched tree rows in a high-density organic orchard.

Because wood mulches are composed of the similar tissues as apple trees, they often contain nutrients in roughly the quantities required in orchards. As chips break down, they will increase soil organic matter content and overall nutrient levels. Cultivation of fresh chips into the soil is not recommended, but decomposed wood chips may be tilled into the soil prior the next application which can speed their decomposition and release nutrients.



Figure 8. Mulch application with Mill Creek spreader, Honey Brook, PA.

Putting it All Together

Ideally, a combination of practices will be used to manage under-tree groundcovers for optimum weed control, soil health, and tree fertility. During the first, and potentially second, year from establishment, a clean strip around trees should be maintained to reduce weed competition via cultivation or (carefully applied) herbicide application. As trees reach third leaf and later, some tolerance for weed completion is acceptable beginning in midsummer. Mulches applied during this time will provide 1-2 years of control, then may be cultivated into the soil and reapplied as necessary. As soil organic matter increases, it may be helpful to take a year off from mulching and use cultivation to reduce soil berms and break up any vole habitat that has formed and knock back established weeds. If herbicides are a consideration, they may be used judiciously during this program to clean up weed issues, especially in fall and/or spring.

Weed management practices in Northeast U.S. apple orchards

<u>Method</u>	<u>Relative Cost</u>	<u>Effectiveness</u>	<u>Advantages</u>	<u>Disadvantages</u>
Hand weeding	High	Moderate	Precision, avoids damage to trees.	High labor cost, back-breaking.
Mowing	Low-med	Moderate	Low cost (mowing row middles anyway).	Not effective for dwarf or new plantings.
Herbicide	Low	High	Precise, adaptable to specific weed issues.	Not organic; potential tree damage; may reduce soil quality; knowledge-intensive.
Flame weeding	Med-high	Low	Quick burndown.	No residual effect; tree damage; fire hazard.
Cover crops	Med	?	Build soil organic matter, outcompete weeds (?).	May be as competitive as weeds; difficult to manage.
Cultivation	Medium	High	Very good weed control if performed correctly.	Decline in soil health; equipment selection, tree damage.
Mulching	High	Medium-high	Improved soil health, organic matter.	Vole habitat (?); need for reapplication; mulch cost; short residual for cost.

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